Temporal Variation of New York State Land Surface Temperature

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Abstract

In New York State, reliable detection of land surface temperature is critical for a wide range of applications. This study used a ten-year (January 2006 to January 2015) series daily observation of land surface temperature from MODIS (moderate resolution imaging spectro-radiometer) sensor to predict the diurnal variation. SPLINE interpolation method was applied to each year's data to estimate the hourly variation. Later, a pixel by pixel correlation was used to all New York State grids to find the local variations. Principal Component Analysis (PCA) technique was utilized to find patterns in dataset. The result of this study provides evidence to compare the pattern of the climate to surface temperature.

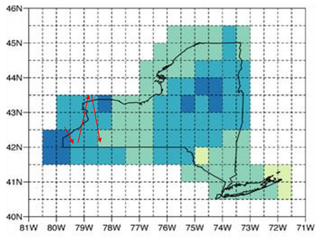
Background/Introduction

- Land surface temperature (LST) is a prominent variable to investigate the degree of earth surface warming obtained from MODIS instrument carried on both Aqua and Terra satellites.
- Terra records data on 10:30 am and pm. Aqua records data on 1:30 am and pm.
- Our goal: Combination of morning and afternoon observations, and presenting a ten-year diurnal variation of LST in New York State using a recommended data analysis techniques.

Dataset

- Raw satellite data were downloaded from the LPDAAC website.
- A geophysical product usually in a gridded map projection format, has 0.25 degree resolution in which the distance between two consecutive latitude and longitude divided into 4 pixels.
- New York State latitude and longitude: 40 – 46 N and 73 – 80 W
- Having extracted the New State data , 138 spatial pixels obtained.

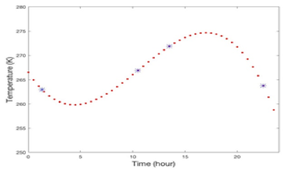
- Figure shows a gridded map of New York State and its location with respect to latitude and longitudes in 0.5 degree resolution.

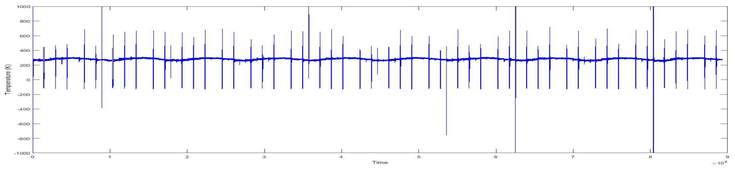


- A series of ten-year satellite observation data, from January 2006 to January 2015 was herein investigated.

Methodology

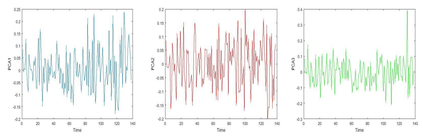
- SPLINE Interpolation for Jan 31 2013 : to extrapolate 48 points out of utmost 4 observations a day.
- Sinusoidal curve is obtained.
- Interpolation of the whole data:



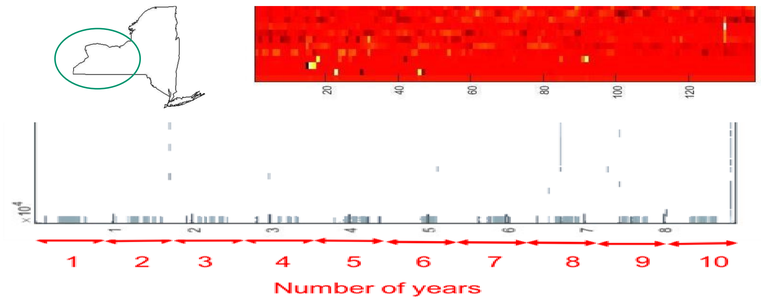


Result

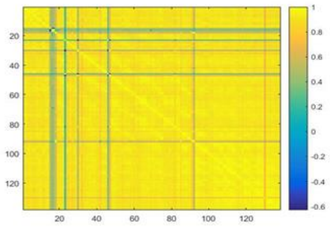
- Comparison of PCAs: The first PCA captures the most variation as the range of the y axis is from 0.25 to -0.2.



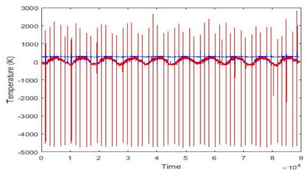
- PCA of the main data: shows the most variation at the first pixels meaning the left side of the state.



- Spatial Correlation and PCA of the correlations: Most Variance captures by applying PCA on the Correlation matrix.
- Close areas correlated and the longitude change results in the sudden reduction of the correlations.

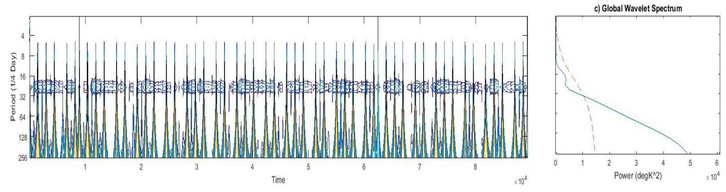


- Time Trend Analysis: To compare the first PCA to the real data range, the time trend of the real data and the first PCA depicted in the following figure.

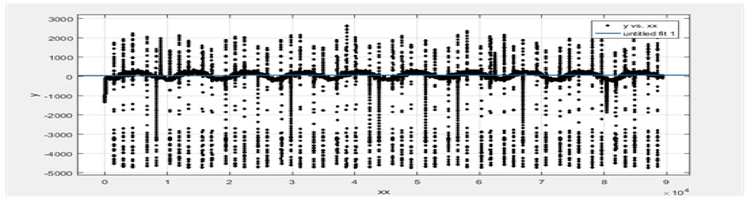


Result

- Wavelet Analysis: To find the best wave fitted to the data of one of the pixel. The period of the 10 years data of one of the pixels.



- Curve Fitting: The time trend of the first PCA was tested to different function,
- The first degree polynomial with Bisquare Robust fitted to the first PCA data.



Conclusion

- Latitude plays a greater role in temperatures than longitude.
- PCA analysis of the main data proves that the first 50 pixels (located in the west side of the state) have the most yearly variation.
- The result of curve fitting shows a light increase in surface temperature through a ten-year period. Note that daily interpolation shows a sinusoidal variation, but a sinusoidal curve cannot be fitted to the ten year data.
- New York State's LST doesn't show as much variation as weather temperature through a 10 year period, meaning that the radiation budget coming from the Sun to the Earth is somewhat constant.

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References

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